

# **ANALYTICAL SOLUTION, INC. (AnSol)**

2/3/2014

## **Analytical Report**

Sample log #: P0107b

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Purchase Order #:

Company : Tradebe Environmental Services  
Address : 4343 Kennedy Ave.  
              East Chicago, IN 46312

Requester : Brian Bodner  
Phone: (219) 354-2396  
Fax:

Sample Description : Flare Gas

Number of Samples : 1

Customer Project:  
Received Date : 1/7/2014

Total Report Page: 7

*Note: This report is submitted to the requester through E-mail only. Please let us know if your need this document security signed, or a hard copy report by mail or fax.*

### **Results:**

All results are attached in following pages.

Submitted by: Sherman S. Chao, Ph.D.

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**Analytical Solution, Inc., 7320 S. Madison, Unit 500, Willowbrook, Illinois 60527**

**ANALYTICAL SOLUTION, INC. (AnSol)**

2/3/2014

**Analytical Report**

Sample log #: P0107b

**GAS COMPONENT ANALYSIS**

Sample ID:	P0107b01	P0107b02	P0107b03	P0107b04
	Flare gas, #1, 12/30/13	Flare gas, #2, 12/30/13	Flare gas, #3, 12/30/13	Flare gas, #4, 12/30/13
Hydrogen	9.16	10.95	3.73	6.39
Carbon monoxide	10.78	10.51	7.82	10.76
Nitrogen	36.6	44.1	55.4	44.1
Oxygen	0.76	0.75	0.64	0.70
Hydrogen Sulfide	<0.03	<0.03	0.288	<0.03
Carbon dioxide	5.45	5.81	5.04	6.85
Methane	16.26	12.15	8.33	11.29
Acetylene	0.01	<0.01	0.03	0.01
Ethylene	6.06	4.07	5.35	6.22
Ethane	3.63	2.39	2.65	2.83
Propane	0.611	0.524	0.628	0.472
Propylene	5.06	3.51	3.24	3.89
Other C4s	0.011	<0.01	0.122	<0.01
i-Butane	0.021	0.036	0.033	0.061
n-Butane	0.052	0.060	0.101	0.040
Butenes	1.51	1.00	1.29	2.03
Other C5s	0.280	0.231	0.277	0.345
neo-Pentane	0.114	0.103	0.115	0.116
i-Pentane	0.004	0.006	0.004	0.004
n-Pentane	0.088	0.053	0.097	0.094
1-Pentene	0.111	0.112	0.229	0.128
Other C6's	0.136	0.119	0.166	0.179
Hexane+	3.26	3.47	4.38	3.39
Relative Density	0.974	0.965	1.069	1.031
Gross HV (dry-)	761	622	643	688
Gross HV (sat-)	748	611	632	676

**Note:** Major component concentrations were normalized to 100% on moisture free basis. Oxygen and Argon cannot be separated; therefore, the oxygen result may include a small amount of Argon. Some results may be reported with additional significance for reference. All components are identified by GC retention times only. GC peak overlap may give false positive results. Additional C4, C5 and C6 components are present and their concentrations are calculated using nC3, nC4 and nC5 standards, respectively.

HV and other calculation are based on 60°F and 14.73 psia. Parameters of n-Hexane are used for Hexane+ components in calculation. For higher accurate measurement, extended hydrocarbon analysis must be performed for the distribution of C6+ components.

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**Analytical Report**

Sample log #: P0107b

**Compound Speciation – Siloxanes as Si in ppmv**

Sample No.:	P0107b01	P0107b02	P0107b03	P0107b04
Description:	Flare gas, #1, 12/30/13	Flare gas, #2, 12/30/13	Flare gas, #3, 12/30/13	Flare gas, #4, 12/30/13
<b>Organic Silicon (siloxanes)</b>				
Tetramethyl silane	<0.20	<0.20	<0.20	<0.20
Trimethyl silanol	2.52	2.23	2.48	1.84
Hexamethyldisiloxane (L2)	1.24	4.67	0.39	4.36
Hexamethylcyclotrisiloxane (D3)	49.9	45.0	14.77	12.05
Octamethyltrisiloxane (L3)	0.21	0.19	<0.20	<0.20
Octamethylcyclotetrasiloxane (D4)	2.84	3.14	0.61	0.61
Decamethyltetrasiloxane (L4)	<0.20	<0.20	<0.20	<0.20
Decamethylcyclopentasiloxane (D5)	0.55	0.44	0.19	0.37
Dodecamethylpentasiloxane (L5)	<0.20	<0.20	<0.20	<0.20
Dodecamethylcyclohexasiloxane (D6)	<0.20	<0.20	<0.20	<0.20
Others (unidentified)	29.5	25.3	76.9	104.5
Total::	86.8	81.0	95.4	123.7

Note: Some results may be reported with additional significance for reference. Others may include traces (BDL) of 10 target compounds. Silicone-based lubricant on the valve stem of Tedlar bag or in the sampling line often contributes a low but significant background level of siloxanes (D5 & D6, mainly).

**ANALYTICAL SOLUTION, INC. (AnSol)**

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**Analytical Report**

Sample log #: P0107b

**Compound Speciation – Siloxane Compounds as Si in mg/M<sup>3</sup>**

Sample No.:	P0107b01	P0107b02	P0107b03	P0107b04
Description:	Flare gas, #1, 12/30/13	Flare gas, #2, 12/30/13	Flare gas, #3, 12/30/13	Flare gas, #4, 12/30/13
<b>Organic Silicon (siloxanes)</b>				
Tetramethyl silane	<0.23	<0.23	<0.23	<0.23
Trimethyl silanol	2.99	2.64	2.94	2.18
Hexamethyldisiloxane (L2)	1.47	5.54	0.46	5.16
Hexamethylcyclotrisiloxane (D3)	59.1	53.4	17.51	14.29
Octamethyltrisiloxane (L3)	0.25	0.23	<0.23	<0.23
Octamethylcyclotetrasiloxane (D4)	3.37	3.73	0.73	0.72
Decamethyltetrasiloxane (L4)	<0.23	<0.23	<0.23	<0.23
Decamethylcyclopentasiloxane (D5)	0.65	0.53	0.22	0.44
Dodecamethylpentasiloxane (L5)	<0.23	<0.23	<0.23	<0.23
Dodecamethylcyclohexasiloxane (D6)	<0.23	<0.23	<0.23	<0.23
Others, as L2	35.1	29.9	91.2	123.9
Total:	102.9	96.0	113.1	146.7

Note: Some results may be reported with additional significance for reference. Others may include traces (BDL) of 10 target compounds. Silicone-based lubricant on the valve stem of Tedlar bag or in the sampling line often contributes a low but significant background level of siloxanes (D5 & D6, mainly).

**ANALYTICAL SOLUTION, INC. (AnSol)**

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**Analytical Report**

Sample log #: P0107b

**Compound Speciation – Sulfur**

Sample No.:	P0107b01	P0107b02	P0107b03	P0107b04
Description:	Flare gas, #1, 12/30/13	Flare gas, #2, 12/30/13	Flare gas, #3, 12/30/13	Flare gas, #4, 12/30/13
Hydrogen sulfide	271	40.8	2848	284
Carbonyl sulfide/Sulfur dioxide	96.2	25.7	240	79.9
Methyl mercaptan	79.8	16.05	277	87.0
Ethyl mercaptan	3.36	1.09	55.6	2.63
Dimethyl sulfide	3.29	3.08	7.40	25.8
Carbon disulfide *	28.2	11.90	38.1	43.8
i-Propyl mercaptan	0.11	0.11	1.59	0.23
t-Butyl mercaptan	<0.10	<0.10	0.14	<0.10
n-Propyl mercaptan	0.38	0.31	5.44	0.48
Methyl ethyl sulfide	0.34	0.31	2.27	0.93
Thiophene	9.97	9.98	17.10	10.64
Diethyl sulfide	<0.10	<0.10	<0.10	<0.10
Dimethyl disulfide *	0.48	0.12	0.13	0.17
Ethyl methyl disulfide *	<0.05	<0.05	<0.05	<0.05
Diethyl disulfide *	<0.05	<0.05	<0.05	<0.05
Others (as S)	8.02	7.94	76.7	8.34
Total S (ppmv):	529	128	3605	586
(mg/M <sup>3</sup> ):	716	173	4879	793

Note: Some results were reported with additional significance for reference. The normal detection limit of each sulfur compound is 0.1 ppmv.

\* 0.1 ppmv sulfur compound = 0.2 ppmv component as sulfur

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Sample log #: P0107b

**Other Components –**

Sample ID:	Conc. Unit	P0107b01
	Description:	Flare gas, #1, 12/30/13
Total organic chlorine	ppmv	1140
	mg/M <sup>3</sup>	1705
Total organic fluorine	ppmv	131
	mg/M <sup>3</sup>	105

# VOC ANALYSIS

February 2, 2014

Sample log No. : P0107b01

Target VOC	Sample ID: Flare gas, #1, 12/30/13	ppmv	Target VOC	ppmv
Dichlorodifluoromethane (12)	274		4-methyl-2-pentanone (MIBK)	43
Chloromethane	<10		cis-1,3-Dichloropropene	<10
1,2-Dichloro-1,1,2,2-tetrafluoroethane	<10		Trans-1,3-Dichloropropene	<10
Vinyl chloride (Chloroethene)	<10		Methylcyclohexane	183
n-Butane	<10		1,1,2-Trichloroethane	<10
Bromomethane	<10		2,3,4-Trimethyl pentane	<10
Chloroethane (Ethyl chloride)	<10		Toluene	2974
Ethanol	<20		Chlorodibromomethane	<10
i-Pentane	<10		2-Methyl heptane	<10
Acetone	48		3-Methyl heptane	<10
Ttrichlorofluoromethane (11)	<10		Ethyl butyrate	<10
2-propanol	<20		1,2-Dibromoethane (Ethylene dibromic	<10
n-Pentane	373		n-Octane	20
Bromoethane	<10		Tetrachloroethene	107
1,1-Dichloroethene (Vinylidene chloride)	181		Chlorobenzene	16
Methylene chloride (Dichloromethane)	<10		1-Cl,4(TFM)BZ	16
3-Chloropropene	<10		1,1,3-trimethylcyclohexane	<10
2,2-dimethylbutane	<10		Ethylbenzene	46
1,1,2-Trichloro,1,2,2-trifluoroethane (113)	<10		m,p-Xylene	98
n-Propanol	<20		3-Me-Octane	<10
1,1-Dichloroethane (Ethylidene chloride)	<10		Bromoform	<10
Methyl tert-butyl ether (MTBE)	<20		Styrene	43
2-Methyl pentane	<10		1,1,2,2-Tetrachloroethane	<10
Meth ethyl ketone (MEK)	2295		o-Xylene	23
3-Methyl pentane	<10		n-Nonane	<10
2-Butanol	<20		Cumene	<10
cis-1,2-dichoroethene	<10		Alpha pinene	<10
n-Hexane	129		n-Propyl benzene	<10
Chloroform	<10		3-Ethyl toluene	<10
Tetrahydrofuran	<20		4-Ethyl toluene	<10
Methyl cyclopentane	42		1,3,5-Trimethylbenzene	<10
1,2-Dichloroethane (Ethylene dichloride)	<10		2-Ethyl toluene	<10
1,1,1-Trichloroethane (Methyl chloroform)	<10		1,2,4-Trimethylbenzene	<10
3-Methyl-2-butanone (MIPK)	<10		n-Decane	<10
1-Butanol	<20		1,3-Dichlorobenzene	<10
Benzene	4963		Benzyl chloride	<10
Carbon tetrachloride	<10		1,4-Dichlorobenzene	<10
Cyclohexane	<10		Cymenes	<10
2-Methyl hexane	107		Limonene	<10
3-Methyl hexane	133		1,2-Dichlorobenzene	<10
1,2-Dichloropropane	<10		Undecane	<10
Bromodichloromethane	<10		1,2,4-Trichlorobenzene	<10
Trichloroethene	12		Dodecane	<10
2,2,4-trimethylpentane/2,2-dimethylhexane	120		Naphthalene	<20
n-Heptane	260		Hexachloro-1,3-butadiene	<10

\* Non-target Components: NA

Note: The test was designed for target VOCs in Biogas, including all TO-14A, some TO-15 and common compounds in BioGas. The noraml detection limits are 0.1-0.2 ppmv. Additional significance may be reported for reference only. Higher detection limit or false positive results may be reported due to poor GC resolution resulted form broad peak shape and closely eluted large unknown compounds. The results should not be used for toal Non-Methane Organic Carbon, total VOCs or total halogens calclation as a large amount of non-target ocmponents are present and not determined.